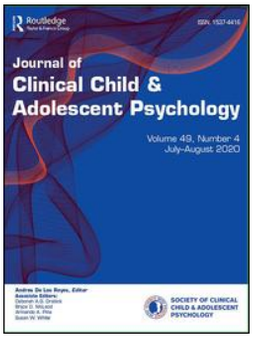

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ABSTRACT

Objective: Autism spectrum disorder (ASD) is significantly over-represented among transgender adolescents. Independently, ASD and gender diversity are associated with increased mental health risks. Yet, mental health in autistic-transgender adolescents is poorly understood. This study investigates mental health in the largest matched sample to date of autistic-transgender, non-autistic (allistic) transgender, and autistic-cisgender adolescents diagnosed using gold-standard ASD diagnostic procedures. In accordance with advancing understanding of sex/gender-related autism phenotypes, slightly subthreshold autistic diagnostic presentations (common in autistic girls/women) are modeled.

Method: This study includes 93 adolescents aged 13–21, evenly divided between autistic-transgender, autistic-cisgender, and allistic-transgender groups; 13 transgender adolescents were at the margin of ASD diagnosis and included within a larger "broad-ASD" grouping. Psychological and neuropsychological evaluation included assessment of mental health, IQ, LGBT stigma, ASD-related social symptoms, executive functioning (EF), and EF-related barriers to achieving gender-related needs.

Results: Autistic-transgender adolescents experienced significantly greater internalizing symptoms compared to allistic-transgender and autistic-cisgender groups. In addition to stigma-related associations with mental health, ASD-related cognitive/neurodevelopmental factors (i.e., poorer EF and greater social symptoms) were associated with worse mental health: specifically, social symptoms and EF gender barriers with greater internalizing and EF problems and EF gender barriers with greater suicidality. Comparing across all ASD and gender-related groups, female gender identity was associated with greater suicidality.

Conclusions: Parsing the heterogeneity of mental health risks among transgender youth is critical for developing targeted assessments and interventions. This study identifies ASD diagnosis, ASD phenotypic characteristics, and EF-related gender barriers as potential risks for poorer mental health in transgender adolescents.

Introduction

Transgender youth face profound mental health risks, particularly in the area of emotional/internalizing disorders: anxiety, depression (Reisner et al., 2015), and suicidality (Peterson et al., 2017). However, emerging evidence suggests a broad range of mental health outcomes among transgender youth, with a subset experiencing few or no mental health concerns (de Vries et al., 2014; Olson et al., 2016). Understanding the risk and resilience factors that underlie the heterogeneity of

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mental health burden in transgender youth is critical to: (1) identify and support those at high risk for mental health problems and (2) develop targeted, personalized interventions that address both the symptoms and the drivers of distress.

A primary focus of transgender youth mental health research has been environmental experiences of acceptance, support, stigma, and rejection and their impact on emotional functioning. This line of research has revealed significant associations, generally with medium effect sizes, between transgender stigma- and rejection-related experiences and mental health/wellbeing (Pariseau et al., 2019; Toomey et al., 2010; Veale et al., 2017). The result of this work has included recommendations for families, communities, and society, such as consistent use of a young person's correct name and pronouns and access to appropriate bathrooms (Russell et al., 2018; Weinhardt et al., 2017).

As impactful as stigma- and rejection-related experiences are, they may not fully account for the elevated mental health concerns among transgender youth. Initial work exploring the higher occurrence of autism spectrum disorder (ASD), ASD-related characteristics, and executive function (EF) challenges in transgender youth suggests that ASD and related neurocognitive characteristics, as well as the impact of these characteristics on the pursuit of gender diversity-related needs, may also contribute to mental health concerns in transgender youth (George & Stokes, 2018b; Strang, Knauss et al., 2020; Strang et al., 2018). Investigation of ASD-related mental health factors in transgender populations is relevant, given the apparent higher occurrence of ASD among gender-diverse individuals: Among studies that have reported *existing clinical diagnoses* of ASD, or that have diagnosed ASD with gold-standard autism diagnostic procedures as part of the study protocol, between 6 and 23% of gender-diverse adolescents and young adults have been reported to have a clinical ASD diagnosis (de Vries et al., 2010; Nahata et al., 2017; Strauss et al., 2017). These studies include youth seeking gender-affirming care in clinics (e.g., de Vries et al., 2010), as well as youth from community samples of self-identified transgender/gender-diverse youth (e.g., Strauss et al., 2017). There are also studies that have identified elevations of autistic *symptoms and traits* in gender clinic-referred youth using ASD screening tools that measure ASD symptoms, but which are not ASD *diagnostic* tools (Akgül et al., 2018; Skagerberg et al., 2015). In the largest study to date ($N = 641{,}860$), which analyzed five separate datasets, the presence of an ASD diagnosis was 3–6.4 times more common in transgender- and gender-diverse-identified individuals than those who were cisgender (Warrier et al., 2020). Emerging evidence suggests that an over-occurrence of gender identity diversity (i.e., report of a gender identity that differs from the sex-assigned-at-birth) may also be observed in gender characterizations of broad ASD populations (George & Stokes, 2018a; Walsh et al., 2018).

The co-occurrence of ASD and gender diversity is associated with greater risks for mental health problems, though available studies of mental health did not confirm ASD with gold-standard evaluation procedures (George & Stokes, 2018b; Hall et al., 2020; Mahfouda et al., 2019). Findings from qualitative studies of well-characterized transgender-neurodiverse (i.e., autistic and slightly subthreshold autistic) youth suggest that social and EF challenges, which are common in ASD, may impede the ability of transgender-neurodiverse youth to conceptualize, initiate, and achieve their gender-related needs and goals (Strang, Knauss et al., 2020; Strang et al., 2018). Social functioning problems have been described by transgender-neurodiverse youth as barriers to understanding and managing the social aspects of gender diversity, such as ways to effectively advocate for gender-related needs and accurately communicate gender identity to others. Likewise, problems with EF have been described as primary impediments to conceptualizing, planning for, and effectively following through with gender affirmation processes (formerly known as "gender transition.") Preliminary evidence suggests elevated EF problems among transgender youth, even beyond elevations expected due to the ASD co-occurrence (Akgül et al., 2018).

The theoretical framework for this study builds on the gender minority stress model (Testa et al., 2017), including well-established findings that perceived stigma and rejection predict poorer mental health in transgender youth (Pariseau et al., 2019; Toomey et al., 2010; Veale et al., 2017). We add to this model ASD diagnosis and ASD symptoms as well as EF problems and EF-related gender barriers as additional hypothesized predictors of poor mental health in transgender adolescents (see Figure 1). In this way, we employ a QUAL → quan framework (Creswell et al., 2011), translating and applying what has been learned from the lived experience of transgender-neurodiverse youth in qualitative research (described above) to a quantitative investigation of transgender youth who have received gold-standard ASD diagnostic characterization. The study aims are as follows. First, we investigate mental health differences between transgender non-autistic (allistic), transgender-ASD, and cisgender-ASD youth in order to assess the potential contributions of ASD, transgender experience, and the interaction of the two on mental health. Second, we examine gender as an additional potential factor related to mental health,

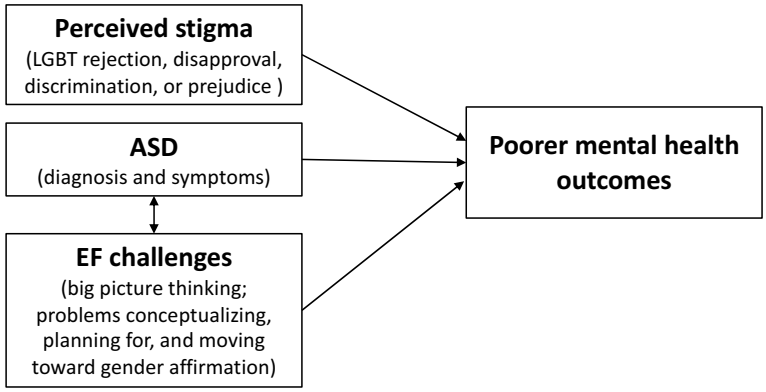


Figure 1. Conceptual framework: predictors of mental health in transgender adolescents.

important given the naturally occurring uneven gender ratios in ASD (i.e., more cisgender males; Loomes et al., 2017) as well as among transgender youth (i.e., more transgender males; Aitken et al., 2015). Third, we model slightly subthreshold ASD presentations observed in some autistic girls and women (Lai & Szatmari, 2020) – and as described in clinical reports, many gender-diverse youth as well (Eckerd, 2020; Ratto et al., 2018; Strang, van der Miesen et al., 2020). Fourth, *among transgender youth specifically*, we investigate the predictive contributions of common transgender youth experiences (i.e., LGBT-related stigma, ASD symptoms, EF challenges and EF-related gender barriers) to mental health functioning.

Hypothesis 1: We predict transgender-ASD youth will show significantly greater mental health burden than allistic (non-autistic) transgender or autistic cisgender youth (George & Stokes, 2018b; Mahfouda et al., 2019).

Hypothesis 2: When accounting for gender along with ASD- and transgender-status, we predict both male gender identity (Toomey et al., 2018) and transgender-ASD status will be associated with greater suicidality.

Hypothesis 3: We predict no differences in mental health findings when excluding versus including from the analyses those transgender autistic youth who are slightly subthreshold in terms of ASD (Bargiela et al., 2016; Eckerd, 2020; Lai & Szatmari, 2020). In other words, although they have slightly fewer ASD indicators than the transgender-strict-ASD group, their mental health profile will be largely consistent.

Hypothesis 4 (in transgender youth, specifically): Moving beyond ASD diagnostic groupings to examine ASD-related phenotypic characteristics (i.e., through a *transdiagnostic* approach) as well as gender-related factors and LGBT-stigma, we hypothesize that EF problems and social symptoms will be associated with poorer mental health in transgender youth. We expect to observe these relationships above and beyond well-documented associations between LGBT-related stigma/rejection and mental health. As described in prior qualitative studies, we predict the experience of EF-related barriers to achieving gender diversity-related needs will be associated with poorer mental health (Strang et al., 2018).

Methods

Participants

Transgender binary youth – in this study defined as youth who identify as the other binary (i.e., male or female) gender – aged 13–21 years, were recruited from the community and from clinical programs in the Washington, DC metropolitan area of the United States, as well as nationally through the ResearchMatch program. Local community recruitment was accomplished through announcements in LGBTQ-related community organizations including PFLAG, and through community advertising in local LGBTQ youth and family Facebook groups. The recruitment age-range was informed by previous work which suggests the age of "coming out" spanning into late adolescence for some transgender-neurodiverse youth (Strang et al., 2018). In order to obtain a transgender sample reflecting a broad spectrum of autistic traits ranging from allistic to full-criteria ASD, recruitment invited transgender youth in general as well as transgender autistic youth. The study required youth and parent participation; hence, participating families were largely accepting of their child's gender diversity. Exclusion criteria were: (1) inability to complete study protocol and/or (2) gender identities

other than binary transgender (i.e., when a transgender young person endorsed any gender that was not male or female, specifically). Of 80 youth and/or families who expressed interest in joining the study, 66 were enrolled: n = 30 from the community; n = 9 from medical gender services; n = 14 from gender development intake services; n = 13 from a neurodiversity-specific gender service. Six families traveled more than two hours to participate. Non-enrolled youth did not participate for the following reasons; youth: changed their mind during the assent process (n = 1); had hearing (n = 1), visual (n = 1), or neurological impairment (n = 2) that precluded full study participation; were interested in the study but parents were not supportive of study participation (n = 2); were outside of the age range (n = 1); or had non-binary or agender gender identity by self-report (n = 6). Additionally, case-control matching was employed with our large community and clinical database of well-characterized autistic youth to derive a cisgender-ASD group (i.e., with self-reported cisgender identity) matched to the transgender-ASD youth. The matching procedure is described below. Table 1 presents participant characteristics.

Characterization and ASD Diagnostics

All participants completed comprehensive ASD diagnostic procedures (see Measures descriptions below), including the Autism Diagnostic Interview-Revised (ADI-R; Lord et al., 1994), Autism Diagnostic Observation Schedule-2 (ADOS-2; Lord et al., 2012), and an additional Diagnostic Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) ASD-based clinical interview. In accordance with best clinical diagnostic practices, the assessments included as much information as families could provide regarding diagnostic histories and developmental features; the assessments were intentionally not masked. The diagnostic process resulted in the final clinical diagnostic ASD-related categorizations. The two ASD diagnosticians were doctoral level clinicians who are research reliable on the ADI-R/ADOS-2 and highly experienced with the diagnosis of ASD. During the study period, 10 of the 66 ADOS-2 administrations were discussed by a large calibration group, including four independently research reliable diagnosticians; these intermittent diagnostic calibration sessions were followed by discussions between the two ADOS-2 administrators to maintain diagnostic consistency. Final ASD-related diagnostic groupings were as follows: allistic (i.e., no/minimal clinically impairing ASD-specific symptoms); strict-ASD (i.e., meeting full DSM-5 ASD criteria); and broad-ASD (i.e., strict-ASD youth *as well as* those youth with clear and significant ASD-related clinical impairment, but who fall slightly below strict-ASD criteria). The inclusion of slightly subthreshold ASD within the "broad-ASD" grouping is in accordance with findings of slightly subthreshold ASD presentations in some autistic girls and women (Eckerd, 2020), as well as in some gender-diverse individuals (Strang et al., 2018). Slightly

Table 1. Participant characteristics.

	Transgender-allistic (TA) n = 26 M (SD)	Cisgender-ASD (CASD) n = 27 M (SD)	Transgender-ASD (TASD) n = 27 M (SD)	Test of differences	Transgender-broad-ASD n = 40 M (SD)
Age (years)	17.02 (2.21)	16.42 (1.90)	17.37 (2.08)	$F(2,77) = 1.44$ $p = .24$	17.24 (2.08)
Parent education (years)	16.83 (2.44)	17.14 (2.03)	16.83 (2.34)	$F(2,64) = .10$ $p = .90$	17.20 (2.27)
IQ estimate (Matrix Reasoning)	54.92 (9.81)	53.91 (9.33)	58.52 (8.43)	$F(2,75) = 1.83$ $p = .17$	58.20 (9.61)
Gender (% female/male)	27/73	41/59	59/41	$\chi^2(2) = 5.72$ $p < .06$	52.5/47.5
Assigned sex at birth (% female/male)	73/27	41/59	41/59	$\chi^2(2) = 7.35$ $\mathbf{p < .03}$ differences: TA vs TASD TA vs CASD	47.5/52.5
Race (%)					
Asian	4.0	14.3	18.5	$\chi^2(2) = 2.64$ $p = .29$	15
Black or African American	4.0	4.8	3.7	$\chi^2(2) = .04$ $p = .98$	2.5
White	92.0	71.4	88.9	$\chi^2(2) = 4.30$ $p = .12$	90
Other	4.0	9.5	0	$\chi^2(2) = 2.72$ $p = .26$	0
More than one reported	4.0	0	11.1	$\chi^2(2) = 2.98$ $p = .23$	7.5
Ethnicity (%) Hispanic or Latinx	8.0	15.8	3.7	$\chi^2(2) = 2.12$ $p = .35$	2.5

subthreshold presentations were operationalized as: strong clinical evidence of ASD-specific impairment (meeting criteria on DSM-5 C-E subdomains), but falling below full DSM-5 criteria by no more than one subdomain in criteria A (reciprocal social) or B (restricted and repetitive behaviors/interests).

In addition to ASD diagnostic characterization, families were asked to provide current existing diagnoses of psychiatric, developmental, or medical conditions. Socioeconomic status was estimated based on the number of years of parental education; in the case of youth with two parents, the number of years of education for each parent was averaged.

Matching Procedure for the Cisgender-ASD Sample

Cisgender-ASD individuals were matched (1:1) on both birth-assigned sex and age to transgender-ASD (strict-ASD) participants using the case-control matching feature ("fuzzy" command) in SPSS 26. Cisgender-ASD participants were matched from a large clinical- and research-recruited database (N = 2,140) of autistic youth from the same metropolitan area as the transgender sample. To be included in the fuzzy match, cisgender-ASD participants were required to have been diagnosed with ASD using the same ASD diagnostic cutoffs as described above for the transgender-strict-ASD group, and to have no self-reported gender-diversity reported in the records or based on the self-report gender identity item on the ASEBA scale (see Achenbach System of Empirically Based Assessment in Measures below). In addition to ASD diagnostic assessments and demographic characterization, the matched cisgender-ASD group had completed the full ASEBA Youth Self Report/Adult Self Report (see Measures below), but not the additional measures employed in this current study.

The groups resulting from the fuzzy match did not significantly differ on age, birth-assigned sex, gender identity, or matrix reasoning score (visual IQ estimate). Birth-assigned sex was selected for matching based on characteristics of the transgender-ASD participants' early developmental profiles. Specifically, based on previously reported differences between cisgender male and female autistic youth (McCormick et al., 2020; Ratto et al., 2018), transgender-ASD participants' early ASD profiles most closely matched patterns of their birth-assigned sex, where transgender-ASD boys had later parent-reported diagnostic concerns and fewer early ASD social signs than transgender-autistic girls. See Study Supplement for supporting analytics.

A matching of the slightly subthreshold ASD group to slightly subthreshold ASD cisgender adolescents was not possible given the lack of symptom-by-symptom DSM-5 diagnostic documentation in our large database (i.e., youth were classified according to whether they met DSM-5 criteria or not, but without database documentation presenting a breakdown of each separate social and restricted and repetitive behavior/interests subdomain met). However, our proportional matching by assigned-sex with the strict-ASD group did have the effect of providing an enriched comparison group of cisgender-ASD females, relevant given that the majority of the slightly subthreshold transgender youth in our sample were assigned female at birth.

Measures

Autism Diagnostic Observation Schedule 2 (ADOS-2)

The ADOS-2 (Lord et al., 2012) is the most commonly used ASD diagnostic measure, developed and validated among autistic and non-autistic children, adolescents, and adults. It includes semi-structured tasks and interview questions which are scored across a range of behavioral indicators. The measure produces two total scores: social communication problems and restricted and repetitive behaviors and interests. Higher scores indicate greater symptoms. In this study, the ADOS-2 was used as part of the ASD-diagnostic procedures, as well as in transdiagnostic analytics as the measure of ASD-related social functioning (social communication total [SocCom]).

Autism Diagnostic Interview-Revised (ADI-R)

The ADI-R (Lord et al., 1994) is a parent/caregiver interview of ASD symptoms and developmental history assessing key ASD-related developmental characteristics from childhood including communication, social development, and repetitive and restrictive behaviors; it was developed and validated in autistic and non-autistic individuals. Scores are aggregated into symptom clusters that correspond to the DSM-IV criteria for a diagnosis of autistic disorder. An adjusted algorithm converting the items into the current DSM-5 ASD diagnostic framework (Mazefsky et al., 2013) was employed for the study's ASD-diagnostic procedures.

Matrix Reasoning from Wechsler Abbreviated Scale of Intelligence-2 (WASI-2)

The WASI-2 (Wechsler & Zhou, 2011) is a well-normed measure of general cognitive abilities. The Matrix Reasoning subtest was administered as an estimate of general thinking skills. The mean score is 50, the standard deviation is 10, and higher scores indicate greater abilities. Matrix Reasoning subtest scores from additional Wechsler intelligence scales were used in some of the matched cisgender-ASD group (*Wechsler Intelligence*

Scale for Children-5 [WISC-5]: n = 8 and *Wechsler Adult Intelligence Scale-5 [WAIS-5]: n* = 14) when WASI-2 scores were unavailable. WISC-5 or WAIS-5 subtest scores were converted to T-scores to match the scaling of the WASI-2 scores.

Utrecht Gender Dysphoria Scale (UGDS)

The UGDS (Cohen-Kettenis & Van Goozen, 1997) assesses the experience of gender dysphoria, including physical- and identity-related aspects of dysphoria. Score range is 12–60, with higher scores related to greater gender dysphoria. Internal reliability has been shown to be strong: Cronbach's α = .80 (Cohen-Kettenis & Van Goozen, 1997). The UGDS has been validated in gender-diverse and cisgender youth: Employing a cut-point of 40, sensitivity is high for identifying gender-referred youth (88.3%) and differentiating non-referred youth (specificity = 99.5%; Steensma et al., 2013). The UGDS was used to characterize level of gender dysphoria between groups, and as an independent variable to account for potential variation in gender dysphoria for regression analytics. Within this sample, internal reliability was acceptable: Cronbach's α = .76 in transgender young women; α = .74 in transgender young men.

Achenbach System of Empirically Based Assessment (ASEBA) Self Report (YSR/ASR)

The ASEBA Self-Report system (Youth Self Report; YSR; age 11–18 years and Adult Self Report; ASR; age 19–59 years; Achenbach, 2009) is a well-validated standardized self-report that measures broad-range emotional and behavioral problems. It is sensitive in autistic as well as transgender populations (de Vries et al., 2011; van der Miesen et al., 2018). Primary summary *T*-scores (M = 50; SD = 10) are generated based on standardization samples, with higher scores representing more problems. The emotional internalizing problems subscale is a summary score reflecting broad experiences of internalized emotional problems, including symptoms of both anxiety and depression. A suicidality composite score has been developed and validated based on item-level ASEBA Self Report data; area under the curve from receiver operating characteristic analysis identifies that the suicidality composite performs well in differentiating youth with and without histories of suicidal behavior (Van Meter et al., 2018). In the current study, the internalizing score and suicidality composite are compared between groups and used as dependent variables in regressions. In addition, a gender-related item, previously employed to capture gender identity diversity (van der Miesen et al., 2018) is used as part of the case-control matching procedure.

LGBT Stigma Scale (LGBT-SS)

The LGBT-SS Perceived Stigma subscale assesses behaviors and interactions related to LGBT discrimination, rejection, prejudice, and stigma at the levels of family and community (Weinhardt et al., 2017); higher scores on this self-report measure indicate greater perceived stigma, and relate to real-world experiences of feeling unsafe regarding gender diversity and broader LGBT identities. This scale has demonstrated strong internal reliability (Cronbach's α = 0.84) and has been psychometrically validated in transgender youth, with findings that higher scores (i.e., greater perceived LGBT-related stigma) are strongly related to specific experiences of day-to-day transgender-related stigma and bias (Weinhardt et al., 2017). The LGBT-SS is used in this study to assess perceived LGBT-related stigma and rejection experiences, which are established predictors of mental health in gender-diverse youth (Pariseau et al., 2019; Toomey et al., 2010; Veale et al., 2017). Within this sample, internal reliability for the LGBT-SS was acceptable: Cronbach's α = 0.74.

Rey-Osterrieth Complex Figure (Boston Scoring System; ROCF)

The ROCF is a neuropsychological measure that captures EF planning skills (Shin et al., 2006). The participant copies the abstract figure, with the color of pen switched every 30 seconds to identify the participant's approach to making the copy. The planning score is derived from detailed coding criteria of efficient/planful versus disorganized approaches to copying the details of the figure (i.e., capturing the "big picture" foundational aspects versus working in a piecemeal and disorganized manner). Higher planning scores represent stronger planning/organization strategies. ROCF performance is associated with broad EF assessments (Somerville et al., 2000) and is often impaired in adolescents with ASD (Kuschner et al., 2009).

Gender-diversity-related Barriers Questionnaire (GBQ)

The GBQ self-report was developed based on transgender youth report of commonly experienced barriers and obstacles to achieving gender-related needs (Strang, Knauss et al., 2020; Strang et al., 2018). The GBQ includes an EF barriers subscale consisting of questions related to the perceived impact of EF challenges on achieving gender-related needs (e.g., "It is hard for me to plan the steps for how to reach my gender needs and goals"). Higher scores reflect greater experience of

barriers. EF barriers scores show convergent validity with a parent-report measure of everyday EF as well as with transgender youth report of whether a young person's gender-related needs are currently met. The GBQ self-report item on parent support is also included in this study; this item asks whether the young person's parents are against the young person moving forward with their gender diversity-related needs and goals. This item shows strong convergent validity with transgender youth report of whether their gender-related needs are currently met. Complete validation characteristics of the two GBQ indexes used in this study are available through the following link: https://childrensnational.org/genderbarriersquestionnaire. Within this sample, the internal reliability of the GBQ was good: Cronbach's α = .80.

Data Analysis

Hypothesis 1: To probe differences in emotional distress and suicidality based on the presence of (1) ASD, (2) gender diversity, and (3) the co-occurrence of ASD and gender diversity, YSR/ASR internalizing and suicidality scores are compared by group (i.e., transgender-allistic, transgender-ASD, matched cisgender-ASD) with ANOVAs and Tukey-adjusted post hoc tests.

Hypothesis 2: To investigate the above Hypothesis 1 group differences *while also accounting for the gender of the participants*, YSR/ASR internalizing and suicidality scores are compared by group, gender, and their interaction, again with ANOVAs and Tukey-adjusted post hoc tests.

Hypothesis 3: Analytics for Hypotheses 1 and 2 above include those autistic youth who meet strict DSM-5 ASD symptom subdomain cutoffs. Analytics for Hypothesis 3 repeat procedures for Hypotheses 1 and 2, now with a combined "transgender-broad-ASD" group consisting of the transgender-strict-criteria-ASD youth along with the transgender slightly subthreshold ASD youth. Similarities or differences with the original Hypotheses 1 and 2 findings are reported. For simplicity of presentation, detailed repeated analytics for Hypotheses 1 and 2 with the transgender-broad-ASD group are included in the Study Supplement.

Hypothesis 4: The transdiagnostic analyses examine, *in the transgender cohort alone*, phenotypic characteristics common in ASD (i.e., social communication differences, planning/organization-related EF challenges) and the experience of gender-related barriers that arise from these traits (i.e., EF-related gender barriers) as predictors of internalizing symptoms and suicidality, while accounting for additional individual characteristics (i.e., age, parent education, gender identity, gender dysphoria, LGBT-related stigma/rejection, and parent support). As a first step, predictor variable scores are compared between transgender-ASD and transgender-allistic youth for characterization. Then, moving away from ASD-specific groupings, YSR/ASR internalizing symptoms and suicidality are each regressed onto the following sequence of variables using stepwise regression for each step: Step 1: demographic variables (age, parent education); Step 2: gender-related variables (gender identity, gender dysphoria); Step 3: LGBT-stigma/rejection-related predictors (LGBT-SS; GBQ Parent Supportive); and Step 4: cognitive/autism-related predictors (ADOS-2 SocCom; ROCF Planning; GBQ EF-Related Gender Barriers).

Neurodiverse-Transgender-informed Interpretation and Contextualization of Findings

In accordance with calls for the inclusion of autistic/neurodiverse transgender co-researchers in research and publications that affect the lives of autistic/neurodiverse gender-diverse people (Strang et al., 2019), some of the scientific members of the analysis, interpretation, and authorship team are autistic (or more broadly neurodiverse) and transgender. However, the gender identities and neurodiversity-related status of the coauthors are not disclosed to maintain appropriate privacy.

Results

Sample Characteristics

Participant characteristics are presented in Table 1. As expected, uneven gender ratios were identified in the transgender-allistic group (73.1% young men); the gender identity ratios between transgender-allistic, transgender-strict-ASD, and cisgender-ASD groups were at the margin of differing statistically (p = .06). The transgender-broad-ASD group, consisting of the transgender-strict-ASD group combined with the 13 transgender youth with clear ASD-related impairment and slightly subthreshold ASD diagnostic presentations, was closer to 50–50 in its gender ratio (47.5% young men). Of the 13 transgender-ASD youth with slightly subthreshold symptom presentations, 9 were transgender young men (69%). Regarding the transgender-allistic youth, although they did not have ASD, many presented with existing neurodevelopmental/psychiatric diagnoses as reported by the parents based on previous clinical evaluations: 65.4% were diagnosed with depressive/mood disorders, 57.7% anxiety disorders, 19.2% AD/HD, and 7.7% post-traumatic stress disorder.

Table 2. Internalizing symptoms and suicidality by ASD and gender diversity-related grouping.

	Transgender-allistic (TA) M (SD)	Cisgender-ASD (CASD) M (SD)	Transgender-ASD (TASD) M (SD)	Test of differences
YSR/ASR Internalizing T-score	61.92 (11.78)	57.70 (12.36)	69.90 (9.23)	$F(76,2) = 8.04$ **$p < .01$** differences: TASD > CASD TASD > TA
YSR/ASR Suicidality Summary Score	.54 (.76)	.52 (.98)	1.19 (1.27)	$F(76,2) = 3.69$ **$p = .03$** differences: TASD > CASD (TASD > TA[a])

[a]Post-hoc comparisons indicate TASD > TA when the analysis is run with the transgender-broad-ASD group, but not when run with the transgender-strict-ASD group.

Hypothesis 1: Mental Health by ASD-related Diagnostic Group and Transgender Status

ASD-related group-based means and tests of difference of YSR/ASR internalizing symptoms and suicidality are presented in Table 2 (transgender and cisgender groups). As predicted, youth with intersecting ASD and gender diversity experienced significantly greater internalizing symptoms than transgender-allistic or cisgender-ASD youth. The average level of internalizing symptoms in transgender-ASD youth was at the cusp of the clinical range (T = 69.90, SD = 9.23; the clinical range is T-scores ≥70). Approximately 51% of transgender-ASD youth were in the clinical range for internalizing symptoms. The transgender-allistic and cisgender-ASD groups' average internalizing symptoms scores were well below the clinical range (T = 61.92 and T = 57.70, respectively).

Suicidality ratings were greater in transgender-ASD than cisgender-ASD youth (see Table 2). The post hoc test comparing transgender-ASD and transgender-allistic youth was not significant after correction (p = .06). Approximately 60% of transgender-ASD youth reported suicidal ideation, as compared to ~35% of transgender-allistic and ~30% of cisgender-ASD youth. About 39% of transgender-ASD youth reported self-harm behaviors as compared to ~15% of transgender-allistic and ~15% of cisgender-ASD youth.

Hypothesis 2: Mental Health by ASD-related Diagnostic Group, Transgender-status, and Gender

Table 3 presents group-based differences in internalizing symptoms and suicidality, including gender identity, ASD and transgender-status grouping, and the interaction of gender identity and ASD/transgender-status grouping in the model. Group-based differences in internalizing symptoms were still observed with gender identity included in the model, with the patterns mirroring the findings from Hypothesis 1 (i.e., greater internalizing symptoms in transgender-ASD youth than in cisgender-ASD or transgender-allistic youth). Gender identity was not associated with differences in internalizing symptoms. Regarding suicidality, when including ASD and transgender-status grouping, gender identity, and the interaction of the two, differences in suicidality were observed by gender identity, with greater suicidality reported in youth with female gender identity across groups; this finding does not confirm our original hypothesis that male gender identity would be associated with greater suicidality. Transgender-ASD young women (i.e., assigned male at birth) had the greatest reported suicidality, while cisgender-ASD young men (i.e., assigned male at birth) reported the lowest levels of suicidality.

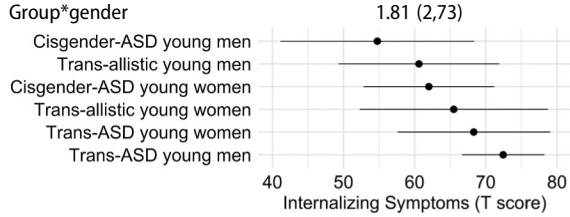
Hypothesis 3: Inclusion of the Slightly Subthreshold Autistic Youth

Analyses for Hypotheses 1 and 2 were re-run with the transgender-broad-ASD group, which included both the transgender-strict-ASD youth along with the transgender-ASD youth who were slightly subthreshold in terms of ASD symptom presentations. Hypotheses 1 and 2 findings related to internalizing symptoms did not change based on the inclusion of transgender-strict-ASD versus transgender-broad-ASD groups. However, findings related to suicidality when the transgender-strict-ASD group was replaced with the transgender-broad-ASD grouping revealed that the broader (more inclusive) grouping of transgender-ASD youth had significantly greater suicidality than both cisgender-ASD *and transgender-allistic groups*. This shift was observed in both the Hypothesis 1 analytics, which do not include gender, and the Hypothesis 2 analytics, which include gender. Regarding the latter, post hoc tests were interpreted in this analysis as both group (transgender-broad-ASD, transgender-allistic, cisgender-ASD) and gender were significant in the overall model. As noted above, all

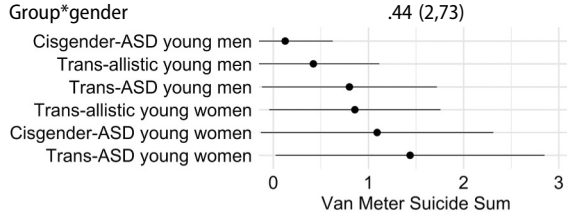
Table 3. Internalizing symptoms and suicidality by ASD-related and gender diversity-related grouping as well as gender.

Transgender-allistic (TA) *versus* cisgender-ASD (CASD) *versus* transgender-ASD (TASD)

		F-test (*df*)	*p*-value	Post-hoc
Internalizing	Group (TA, CASD, TASD)	7.48 (2,73)	**< .01**	TASD > TA TASD > CASD
	Gender	1.02 (2,73)	.32	
	Group*gender	1.81 (2,73)	.17	



		F-test (*df*)	*p*-value	Post-hoc
Suicidality	Group (TA, CASD, TASD)	2.09 (2,73)	.13[a]	(see note below)[a]
	Gender	8.52 (1,73)	**< .01**	Female > Male
	Group*gender	.44 (2,73)	.65	



[a]ANOVA is significant for "Group" (in addition to "Gender") when run with the transgender-broad-ASD group, but not when run with the transgender-strict-ASD group. For the analysis with the transgender-broad-ASD group, post-hocs indicate TASD > CASD and TASD > TA.

statistics repeated for Hypothesis 3 are presented in the Study Supplement.

Hypothesis 4: Transdiagnostic Associations with Mental Health in the Transgender Cohort

Preliminary Characterization of Groups across the Measures

For initial characterization across the broad gender, cognitive, and developmental measures used in the transdiagnostic analytics below, group-based differences of the independent regression variables are reported in Table 4. Transgender-ASD youth had significantly greater social problems (ADOS-2 SocCom) and EF-related gender barriers (GBQ) than transgender-allistic youth. They also had overall lower scores on the gender dysphoria scale (UGDS; i.e., less reported gender dysphoria); although this finding was statistically significant, all transgender youth (ASD and allistic) were above UGDS cutoff scores indicating pressing clinical gender need (i.e., cutoff score > 40). EF planning skills (ROCF) did not differ significantly between transgender-ASD and transgender-allistic youth.

Transdiagnostic Regression Analyses

Moving beyond ASD-related diagnostic group classification to a transdiagnostic model of associations with mental health, internalizing problems (Table 5, left) and suicidality

Table 4. Gender dysphoria, LGBT stigma, gender-related barriers, ASD symptoms, and executive function in allistic versus autistic transgender youth.

	Transgender-allistic (TA) M (SD)	Transgender-ASD (TASD) M (SD)	Test of differences	Transgender-broad-ASD M (SD)
Utrecht Gender Dysphoria Scale	56.08 (3.94)	52.65 (5.69)	$t(44.57) = -2.51$ **$p < .02$**	53.28 (5.42)
LGBT Stigma Scale	9.96 (4.13)	9.96 (4.12)	$t(50) = .000$ $p = 1.0$	10.05 (3.82)
Gender Barriers Questionnaire: Parent supportive	65.4%	59.3%	$\chi^2(1) = .212$ $p = .65$	65%
ADOS-2: Social Communication	2.73 (3.12)	10.77 (5.04)	$t(41.70) = 6.91$ **$p < .001$**	8.85 (4.99)
Rey-Osterrieth Complex Figure Planning Score	2.35 (1.13)	1.92 (1.13)	$t(50) = -1.35$ $p = .18$	2.15 (1.16)
Gender Barrier Questionnaire: Executive Function-Related Gender Barriers Total	.62 (.58)	1.15 (.74)	$t(49.11) = 2.91$ **$p < .01$**	1.12 (.70)

Table 5. Internalizing symptoms and suicidality regressed on age, SES, gender, LGBT stigma/rejection, and cognitive/neurodevelopmental factors.

	Internalizing					*Suicidality*				
Predictor	β	*B*	*SE*	*t*	*p*	β	*B*	*SE*	*t*	*p*
Step 1: Age, SES										
Age	.16	.83	.66	1.26	.21	−.01	−.01	.06	−.08	.94
Parent education (years)	.07	.33	.61	.54	.60	−.01	−.003	.06	−.05	.96
Model Summary	$F(2,61) = .92$, $p = .40$, $\Delta R^2 = .03$, Cohen's $F^2 = .03$					$F(2,61) = .004$, $p = 1.00$, $\Delta R^2 = .00$, Cohen's $F^2 = 0.00$				
Step 2: Gender										
Age	.21	1.11	.72	1.54	.13	−.07	−.04	.07	−.53	.60
Parent education (years)	.10	.49	.63	.78	.44	−.03	−.01	.06	−.23	.82
Gender	.06	1.26	3.10	.41	.69	.38	.81	.28	**2.87****	**<.01**
Gender dysphoria (UGDS)	.20	.44	.32	1.39	.17	.14	.03	.03	1.01	.32
Model Summary	$F(4,59) = .95$, $p = .44$, $\Delta R^2 = .03$, Cohen's $F^2 = .03$					$F(4,59) = 2.08$, $p = .10$, $\Delta R^2 = .12$, Cohen's $F^2 = .14$				
Step 3: LGBT Stigma/Rejection										
Age	.02	.10	.77	.14	.89	−.20	−.10	.07	−1.39	.17
Parent education (years)	.11	.53	.60	.89	.38	−.02	−.01	.06	−.17	.87
Gender	.11	2.36	2.98	.79	.43	.42	.89	.28	**3.19****	**<.01**
Gender dysphoria (UGDS)	.14	.31	.30	1.03	.31	.10	.02	.03	.71	.48
Perceived LGBT stigma (SS)	.42	1.16	.42	**2.76****	**<.01**	.32	.08	.04	**2.10***	**.04**
Parent supportive of gender-needs (GBQ)	−.04	−.98	3.28	−.30	.77	−.09	−.19	.31	−.62	.54
Model Summary	$F(6,57) = 2.176$, $p = .059$, $\Delta R^2 = .126$, Cohen's $F^2 = .144$					$F(6,57) = 2.21$, $p < .06$, $\Delta R^2 = .07$, Cohen's $F^2 = .07$				
Step 4: Cognitive/Neurodevelopmental										
Age	.06	.33	.70	.48	.63	−.17	−.08	.07	−1.27	.21
Parent education (years)	.06	.28	.55	.50	.62	−.10	−.05	.05	−.92	.36
Gender	−.07	−1.58	2.88	−.55	.59	.25	.53	.27	1.98	.05
Gender dysphoria (UGDS)	.15	.33	.28	1.18	.24	.05	.01	.03	.43	.67
Perceived LGBT stigma (SS)	.45	1.24	.39	**3.15****	**<.01**	.30	.08	.04	**2.11***	**.04**
Parent supportive of gender-needs (GBQ)	−.11	−2.59	3.04	−.85	.40	−.15	−.32	.28	−1.14	.26
ASD social symptoms (ADOS-2: SocCom)	.31	.66	.27	**2.45***	**<.02**	.09	.02	.03	.70	.49
Executive functioning (ROCF Planning)	−.13	−1.30	1.19	−1.09	.28	−.27	−.25	.11	**−2.22***	**.03**
Executive function-related gender barriers (GBQ)	.25	4.09	1.99	**2.06***	**<.05**	.38	.58	.19	**3.13****	**<.01**
Model Summary	**$F(9,54) = 3.52$**, $p < .01$**, $\Delta R^2 = .18$, Cohen's $F^2 = .22$					**$F(9,54) = 3.72$**, $p < .01$**, $\Delta R^2 = .19$, Cohen's $F^2 = .24$				

*$p < .05$.
**$p < .01$.
Table Legend: The R^2-change value for each step in the hierarchical regression is reported, along with the Cohen's F^2, the latter of which is a measure of R^2 effect size where, 0.02 = small effect, 0.15 = medium effect, and 0.35 = large effect.

(Table 5, right) were separately regressed onto planned variables of interest. Accounting for age and socioeconomic status (Step 1), gender-related variables (gender, UGDS; Step 2), LGBT stigma-related variables (LGBT-SS; GBQ-Parent support; Step 3), and cognitive/autism-related variables (ADOS-2 SocCom, ROCF; GBQ-EF related gender barriers; Step 4) identified the following key associations with internalizing symptoms: Greater perceived LGBT-related stigma (LGBT-SS), social functioning problems (ADOS-2 SocCom), and EF-related gender barriers (GBQ) were related to greater internalizing symptoms. The R^2 change with the addition of the LGBT-related stigma-related variables (Step 3) approached statistical significance, while the R^2 change with the addition of the cognitive/autism-related variables (Step 4) was associated with a significant change of medium effect size (Cohen's F^2 = .224). Regarding suicidality, greater perceived LGBT-related stigma (LGBT-SS), poorer executive functioning (ROCF Planning), and greater EF-related gender barriers (GBQ-EF) were related to increased suicidality. Of note, by Step 4, gender was at the margin of statistical significance in predicting suicidality in the direction of female gender identity relating to greater reported suicidality (p = .05); in Steps 1–3, gender was a significant predictor. In the suicidality-based regression, the R^2 change with the addition of the LGBT-related stigma variables (Step 3) approached statistical significance, while the R^2 change with the addition of the cognitive/autism-related variables (Step 4) was associated with a significant change of medium effect size (Cohen's F^2 = .241).

Discussion

This is the first study comparing mental health status in proportionally balanced groups of transgender-ASD, transgender-allistic, and cisgender-ASD adolescents. Importantly, this study includes the largest transgender-ASD sample to date characterized through comprehensive, gold-standard ASD assessment. By balancing ASD-related characteristics in a carefully recruited/characterized autistic and allistic sample, this study allows for evaluation of associations between ASD status, as well as ASD-related cognitive traits (i.e., social and EF challenges), and mental health. As hypothesized, internalizing symptoms were greater in transgender-ASD youth than transgender-allistic and matched cisgender-ASD youth: Slightly more than half of transgender-ASD youth were in the clinical range for internalizing symptoms. Also as predicted, ASD-cognitive and neurodevelopmental factors – in addition to well-established stigma-related factors (LGBT bias, rejection, victimization) – were associated with poorer transgender adolescent mental health. Consistent with qualitative findings from transgender-neurodiverse adolescents (Strang et al., 2018), the experience of barriers achieving gender diversity-related needs due to EF challenges was associated with increased internalizing symptoms and suicidality. Of note, the cognitive and neurodevelopmental predictors (social symptoms, EF, EF-related gender barriers) explained more variance in both internalizing symptoms and suicidality than LGBT stigma-related factors. The findings of this study are particularly important given the significantly higher occurrence of ASD, ASD-related traits, and EF problems among transgender youth and adults (Akgül et al., 2018; Hisle-Gorman et al., 2019; van der Miesen et al., 2016; Warrier et al., 2020). ASD diagnosis, ASD-related traits, and EF problems now emerge as potential specific risk factors for poorer transgender adolescent mental health. These results also highlight the ASD-gender diversity co-occurrence as associated with greater mental health burden overall than either ASD or gender diversity alone.

A novel feature of this study was the examination of patterns of mental health based on diagnostic group (i.e., the presence or absence of ASD) as well as transdiagnostic features. The transdiagnostic approach, which probes specific capacities and experiences beyond ASD status alone, may be particularly promising for identifying mechanisms/intervention targets impacting mental health across broader groups of transgender youth. For example, when investigating the contributions of gender, perceived LGBT-related stigma, ASD-related social symptoms, EF skills, and a young person's experiences of EF-related barriers to achieving their gender-related needs, EF-related gender barriers was predictive of both internalizing symptoms and suicidality in the full transgender cohort, and demonstrated the largest single effect size relationship of any of the predictors of suicidality.

EF Planning Skills and Suicidality

In addition to EF-related gender barriers, the study also highlights a link between EF planning capacities (ROCF) and suicidality. The ability to plan and think into the future (i.e., "big picture thinking") may facilitate contextualization of and coping with one's current situation (e.g., "there are difficulties now, but I can see a path to improving this situation in the future.") For transgender youth who struggle with planning and organization, it may be harder to cope with current stressors, causing suicidal thoughts and behaviors to manifest. ASD-related difficulties with contextualization, future thinking, planning, and big picture thinking have been conceptualized under a number of different cognitive frameworks including EF, central coherence (Happé & Booth, 2008), and

predictive coding (Van de Cruys et al., 2014). EF planning problems are common in ASD, and ROCF performance has been shown to be poorer in autistic versus typically developing youth (Kuschner et al., 2009). Yet, findings in the current study indicate that the transgender-allistic and transgender-ASD groups did not differ in ROCF performance, and poorer ROCF performance was associated with suicidality even after accounting for ASD-related social symptoms in the model. These findings are in line with a previous report that EF problems may be more common in transgender youth, even beyond the EF problems expected due to the ASD co-occurrence (Akgül et al., 2018).

Gender and Mental Health

Gender was not related to internalizing symptoms in any analyses, but appeared to play a role in the associations with suicidality, particularly when the analytics included both autistic groups (cisgender-ASD and transgender-ASD). Specifically, female gender identity emerged as a possible predictor of greater suicidality when examining across gender identity and ASD-status; findings for female gender were at the margin of significance in the transdiagnostic regression analyses of suicidality when accounting for all other predictors (e.g., LGBT stigma, ASD-related social symptoms, EF, and EF-related gender barriers). Overall, transgender-ASD youth showed suicidality profiles more closely *matching their gender identity*, with transgender-ASD young women more similar to cisgender-ASD young women (i.e., both expressing greater suicidality; Hirvikoski et al., 2020). This finding contrasts with our initial hypothesis of greater suicidality in transgender young men compared to transgender young women, though the report that informed the hypothesis was from a sample that did not proportionally recruit transgender-autistic adolescents (Toomey et al., 2018). This contrast in findings with the broader transgender literature highlights that the intersectionality of ASD and gender diversity may present with unique patterns and risk factors that differ from transgender youth in general.

The finding of greater suicidality in autistic individuals with female gender identity (transgender or cisgender), where patterns of suicidality appear to follow a young person's *gender identity*, counterpoints with our findings that transgender-ASD youth showed early ASD-related diagnostic profiles *aligning most closely with their sex-assigned-at-birth* (i.e., fewer early observed social communication symptoms and later identification of ASD-related problems in transgender-ASD young men compared to transgender-ASD young women; see Study Supplement). This contrast encourages consideration of both gender identity *and* sex-assigned-at-birth for analytics when comparing transgender and cisgender populations. Future research should investigate sex- and gender-based ASD profiles in more detail, with consideration for how the intersection of assigned sex and gender diversity in ASD may result in specific nuanced ASD and/or mental health profiles beyond binary "male"- or "female"-typical presentations.

An additional potential consideration for interpreting the findings regarding gender and suicidality is that greater suicidality associated with being autistic and female (i.e., transgender-female or cisgender-female) might stem from different characteristics and/or life experiences depending on whether a young person is transgender or cisgender. For example, transgender-autistic young women might experience greater social stigma and less acceptance related specifically to the unique challenges of being a transgender woman (Verbeek et al., 2020), which may drive increased mental health burden. Cisgender-ASD young women, on the other hand, may engage in more social compensatory processes (e.g., "masking" or "camouflaging"), which are more common in autistic people with the so-called "female autism phenotype" (Hull et al., 2020; Lai & Szatmari, 2020) and which are associated with increased suicidality (Cassidy et al., 2019).

Slightly Subthreshold ASD in Some Transgender Youth

This study is the first to employ gold-standard ASD assessment to characterize transgender adolescents' intensity of ASD diagnostic features. We identified a substantial number of transgender youth (i.e., almost 20% of our sample) who fell just below strict DSM-5-based ASD symptom cutoffs, but who experienced clinical level ASD-related problems and impairments. Gender-diverse youth with this profile have been described previously (Strang et al., 2018), and our present findings hint that being transgender and at the margin of the ASD diagnosis, as compared to meeting strict ASD criteria, may be associated with similar levels of mental health concerns. Including the slightly subthreshold transgender-ASD youth in the analyses along with the transgender-strict-ASD group did not reduce any of the strength of the mental health findings, and in fact, showed the opposite pattern for two analyses. Of the slightly subthreshold youth, the majority were transgender young men (i.e., assigned female at birth). In this way, the "female autism phenotype" may be relevant in gender-diverse youth, and especially transgender-

autistic young men. However, the current "female"-focused descriptions of this phenotype (e.g., "female ASD phenotype" or the "common female presentation of ASD") are problematic in the population of gender-diverse youth, as they do not take into account gender identity properly, which may differ from assigned-sex and karyotype. Therefore, we call upon researchers, clinicians, and advocates to work together to identify other terms for this profile – terms inclusive and respectful of gender-diverse youth who may not identify with female gender (Strang et al., 2019).

Other Forms of Neurodiversity

An important design feature of this study was that the transgender-allistic group was not constrained to typically developing (TD; i.e., "neurotypical") youth, as is often done in studies of ASD (i.e., recruiting a TD comparison group). Instead, the transgender-allistic group was defined as "not autistic," and there were no other mental health/developmental exclusions placed on recruitment, except inability to complete study measures due to hearing, vision, or intellectual disability. This meant that the transgender-allistic group could more closely follow the natural sampling of transgender youth in general; hence, findings may be more generalizable to real-world populations. Of note, almost 20% of the transgender-allistic adolescents had been diagnosed with AD/HD (according to parent report) prior to participating in the study. These rates of AD/HD are above population AD/HD prevalence rates (Danielson et al., 2018). Previous work has explored the potential higher occurrence of gender diversity among youth with AD/HD (Strang et al., 2014), as well as the potential over-representation of AD/HD among transgender adults (Cheung et al., 2018). The presence of AD/HD in general populations is associated with greater EF and mental health problems, including increased suicidality (Balazs & Kereszteny, 2017; Barkley, 1997; Elia et al., 2008). Therefore, a potential over-representation of AD/HD among transgender youth, in addition to the established ASD overrepresentation, might explain a portion of mental health elevations in gender diverse young people. It is also possible that the presence of AD/HD and gender diversity could have interactive effects, similar to the ASD and gender diversity co-occurrence (e.g., AD/HD-related EF challenges compounding challenges achieving gender-related needs). In fact, the presence of over-represented AD/HD may explain in part why EF-related planning skills did not significantly differ between transgender-autistic and transgender-allistic groups, and why EF-related gender barriers were related to mental health in the transdiagnostic model, even when accounting for ASD-related social impairment. Future studies should employ gold-standard AD/HD assessments to probe the relative contributions of both ASD and AD/HD. Using a similar analytic approach as presented in this study, clinically-confirmed ASD and AD/HD could be placed together in predictive models, including their intersection/overlap, given the common co-occurrence of the two (Jang et al., 2013).

Accommodating and Supporting EF

The identification of mechanisms exacerbating mental health problems in transgender youth may ultimately facilitate the development of transgender-specific screenings, assessments, and interventions targeting drivers of mental health disparities in this population. Clearly, a promising candidate mechanism is EF-related barriers to achieving gender-related needs. Our autistic transgender self-advocate co-researchers describe many ways that EF challenges can impede the pursuit and achievement of gender-related needs. These problems include: coordinating and keeping track of gender-related care, which often spans multiple disciplines/providers; planning for effective self-advocacy around clinical needs with gender-providers in the context of fast-paced medical visits; flexibly coping with changes that occur from gender affirmation/transition (e.g., managing unfamiliar sensory experiences); sustaining ongoing routines for gender-affirming medical interventions (e.g., keeping track of medication prescriptions); and navigating the organizational complexities of correcting legal gender and name identification documents. There is evidence for the effectiveness of both EF accommodations as well as specific intervention approaches to improve EF skills in youth in general (Kenworthy et al., 2014; Ylvisaker et al., 2003). Drawing on extant techniques for accommodation and intervention, the application or tailoring of existing EF approaches and/or the development of transgender-youth-specific EF supports may reduce the experience of EF-related barriers to advancing one's gender needs and goals. For example, visual organizational aids for navigating the steps of gender discernment and gender affirmation could help to reduce EF barriers. Pre-rehearsed scripts for interacting with gender-care providers could reduce the EF load of social interactions in health-care settings, and an online health portal summarizing session visits could help transgender-neurodiverse youth to better process and organize clinical information. Neurodiverse gender-diverse youth, themselves, have identified additional potential

strategies and supports, including making concrete the various approaches to achieving gender-related needs through gender-related mentoring and engaging with adult role models (i.e., exemplars) who have already navigated numerous gender-related challenges (Strang, Knauss et al., 2020).

Limitations

Although the transgender sample in this study is the largest to date characterized with gold-standard ASD diagnostic procedures, larger samples will allow for more precision in examining relationships, particularly those based on gender. Given the unevenness of the naturally occurring gender ratios in our groups, purposive sampling techniques across multiple geographic locations might allow for more balanced recruitments in future studies. However, a multi-site approach also has challenges, as the comprehensive ASD-related diagnostic approaches employed in this study benefited from a central ASD-diagnostic team who could meet together to review ADOS-2 administrations, ensuring assessment consistency. Multi-site studies would need to find ways of unifying ASD-diagnostics, particularly given the complexity of diagnostics in the slightly subthreshold ASD group who make up an important portion of this population. In the current study, we had no means of precisely conducting case-control matching with slightly subthreshold cisgender-ASD youth; this will be an important goal for future research efforts in this field.

Another limitation was the exclusion of gender nonbinary youth in order to provide a more focused analytic approach; the inclusion of nonbinary youth would have further stretched the power demands for analyses given the additional gender-related grouping. Future studies should include gender nonbinary youth, as recent findings indicate that ASD-related characteristics may have higher representation in nonbinary populations (Stagg & Vincent, 2019). Regarding gender diversity more broadly, this study characterized gender identity and gender diversity with current gold-standard gender assessments, which do not take into account whether gender development in autistic youth is similar to gender development in allistic youth (Van Schalkwyk et al., 2015).

Our sample was not representative in terms of race or ethnicity. Although care was taken to recruit from both community and clinical settings, the sample was primarily white and with higher SES, a common problem in studies of transgender youth as well as in studies of ASD (Nahata et al., 2017; Ratto et al., 2017). Also, our sample was not fully representative given the high degree of parent affirmation and support: Parents were required to participate, meaning that enrolled caregivers were to some degree accepting of their children's gender diversity. Additionally, our assessment of context within the family was limited; for example, we measured parent education, but no broader indicators of socioeconomic status.

Our assessment of stigma and rejection-related experiences was limited to broad LGBT-related stigma, which presents two challenges: we did not capture dimensional aspects of gender minority stress experiences (i.e., those experiences most specific to transgender youth) and we did not assess ASD-related minority stress and stigma. Precision assessment of both gender minority and neurodiversity-related stigma and stress will be important future directions in studies of this population. Finally, the cross-sectional design allowed for the exploration of relationships, but did not allow for the testing of mechanisms driving the development of mental health problems. Future studies may build on the assessment approaches used here and employ a longitudinal design to predict mental health profiles and outcomes over time. Longitudinal approaches following transgender-allistic and transgender-autistic youth into adulthood should also probe trajectories of resilience and empowerment. For example, there are numerous well-known transgender-autistic self-advocates who, drawing upon both their *neurodiverse and gender-diverse identities*, have made remarkable contributions to the wellbeing and rights of transgender people around the world (Strang et al., 2019).

Conclusions

This study identifies cognitive and autism-related features common among transgender youth associated with increased mental health problems. Specifically, the presence of clinically-confirmed ASD, ASD-related social impairment, EF planning difficulties, and EF-related gender barriers each related to greater mental health burden. Employing state-of-the-art ASD diagnostic approaches that sought to characterize and include adolescents with autistic phenotypes common in girls and women, this study identified a notable subset of this slightly subthreshold DSM-5-based ASD phenotype in transgender youth, suggesting the importance of comprehensive and nuanced ASD-related diagnostic procedures for transgender young people. Given the mental health risks experienced by many transgender adolescents, the present findings indicate the importance of considering cognitive and neurodevelopmental factors, in addition to LGBT-related stigma/rejection, when

developing supports and interventions to optimize emotional wellbeing in transgender young people.

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No potential conflicts of interest were reported by the authors.

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